FIRST PUBLIC WORKSHOP

Reducing Global Warming Impacts of HFC-134a Used in Motor Vehicle Air Conditioning Systems

California Air Resources Board
Sacramento, California

February 5, 2008

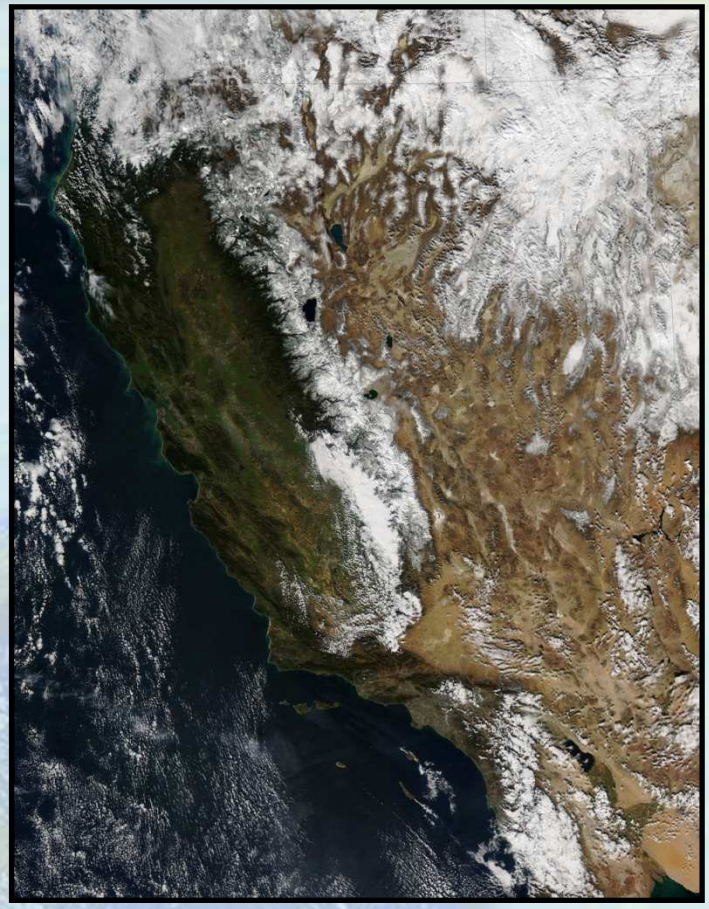
Workshop Agenda

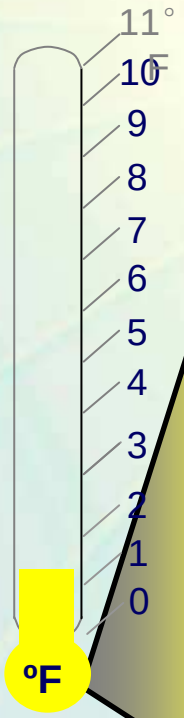
1. **Background**
   - Assembly Bill 32
   - Early Actions
   - Motor Vehicle Air Conditioning (MVAC)
     - Overview of process
2. **Do-It-Yourself (DIY) Small Can Regulation**
   - U.S. Environmental Protection Agency (EPA) study
   - California Air Resources Board (ARB) study
   - Society of Automotive Engineers (SAE) perspective
   - Potential options being considered in California
   - Automotive Refrigerant Products Institute (ARPI) perspective
3. **Other Early Action MVAC Measures**
4. **Schedule/Next steps**

Section 1
Background

Dr. Tao Huai
California Air Resources Board

California Climate Impacts (over the past 100 years)





1.3 ºF higher temperatures

~7 inch sea level rise

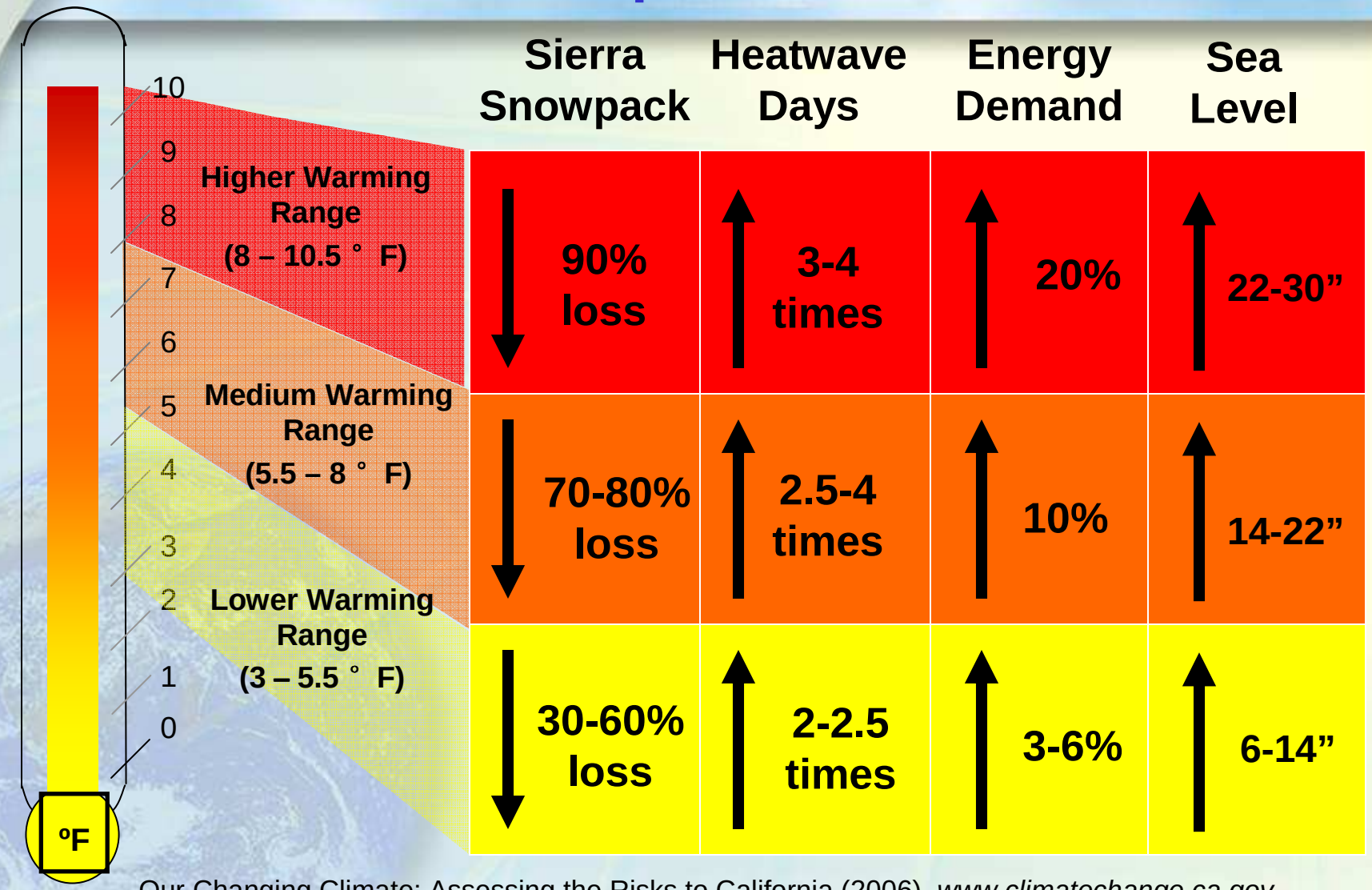
12% decrease in fraction of runoff between April and July

Snowmelt and spring blooms advanced 2 days/decade since 1955

4-fold increase in wildfire frequency (over 34 years)

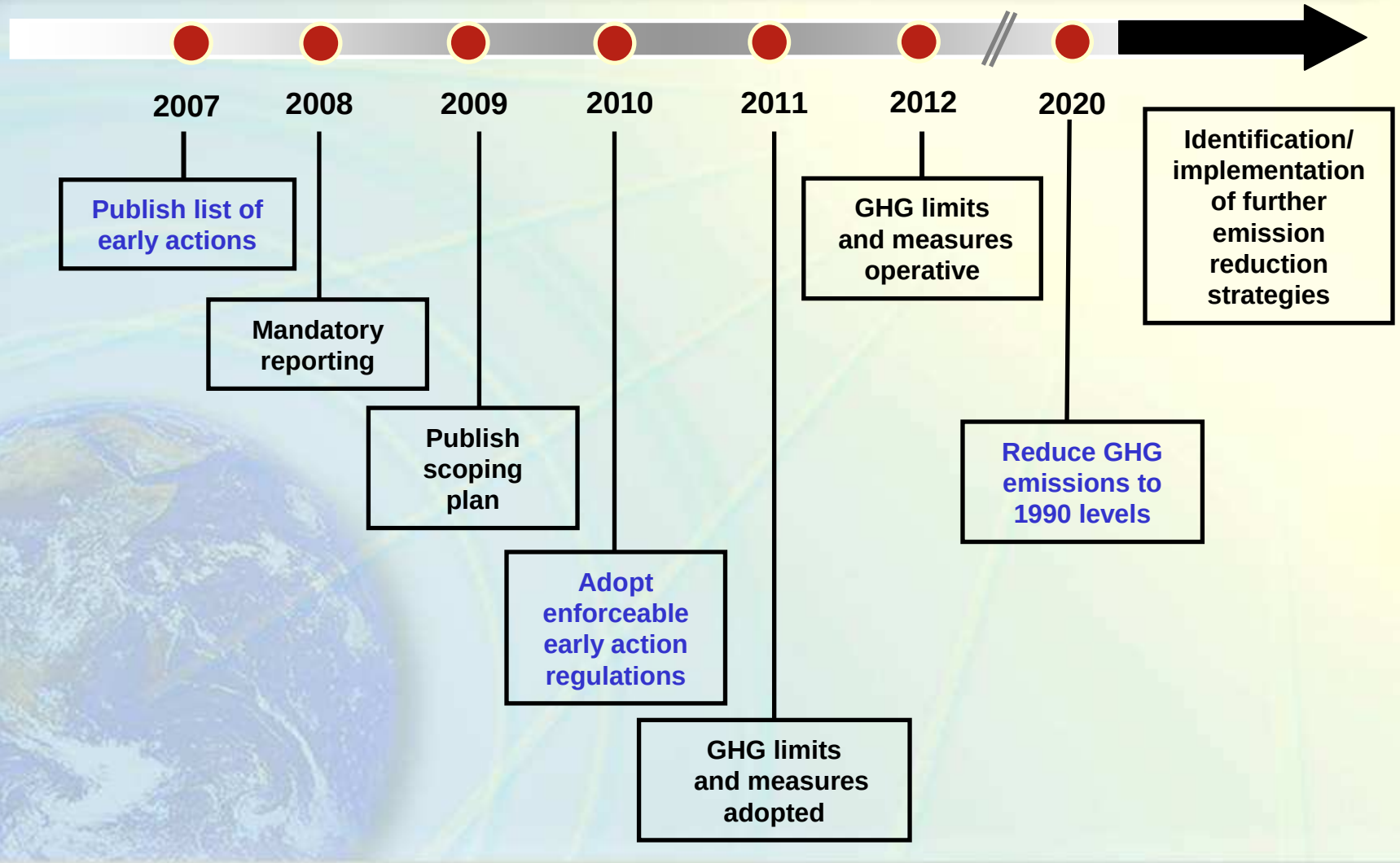
Cal/EPA-OEHHA, "Environmental Protection Indicators for California" (2002), w*ww.oehha.ca.gov/multimedia/epic/ Epicreport.html* Westerling et al., "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity", *Science* (2006)

Projected Climate Impacts on California
2070-2099 compared with 1961-1990



Our Changing Climate: Assessing the Risks to California (2006), *www.climatechange.ca.gov*

California Global Warming Solutions Act of 2006 (AB 32)



Reductions Required by AB 32

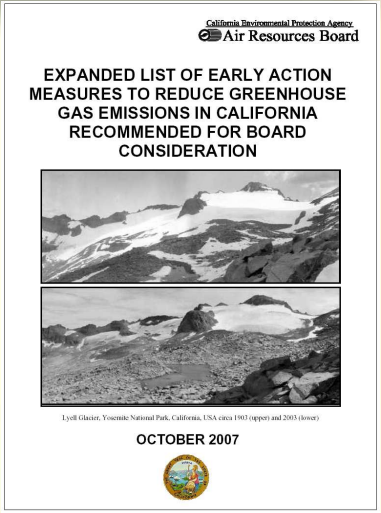
- **BAU without action would generate annual greenhouse gas (GHG) emissions of about 175 MMTCO$_2$E above 1990 levels by 2020**
- **Approximately 43 MMTCO$_2$E of 2020 BAU GHG emissions would be due to high- global warming potential (GWP) gases**
- **Each MMTCO$_2$E is equivalent to annual emissions of 216,000 cars or the electricity used by 193,000 California households**

Scoping Plan Development

- **Scoping Plan**
  - Describe how California will reduce GHG emission levels to 1990 levels by 2020
  - Provide a vision for a low carbon future (2020 and beyond)
  - Further define California's leadership in combating climate change
  - Maximize benefits to California
  - Anticipated Board Hearing Dates: Nov 20-21, 2008
  - http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm
- **MVAC included in High-GWP GHG Sector**
- **All Board-approved Early Actions included**
- **Soliciting ideas for further reductions**

Early Actions

- AB 32 required ARB to identify/publish a list of early action GHG emission reduction measures
- Six early action measures are related to MVAC
- Total emission reduction potential for MVAC improvement ~ 5 $MMTCO_2E$ in 2020



STRATEGY NAME	2020 Reduction ($MMTCO_2E$)	Board Hearing
Reduction of HFC-134a from DIY MVAC servicing	1	2008, 4th Quarter
Cool automobile paints	1	2009, 2nd Quarter
Ban of HFC release from MVAC service / dismantling	0.1	2009, 4th Quarter
Requirement of low-GWP GHGs for new MVACs	2.5	2010, 4th Quarter
Add AC leak tightness test and repair to Smog Check	0.5	2011, 1st Quarter
Shipping containers tracking, reporting, and recovery program	0.1	2011, 4th Quarter

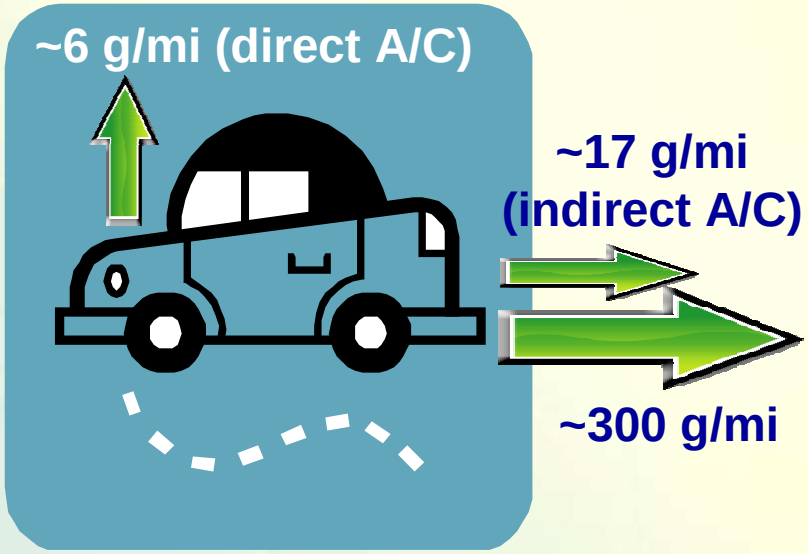
MVAC Usage Related Emissions

- **MVACs are the largest end user of HFC-134a**
  - High growth sector
  - GWP 1300 times CO_2
  - One 12 Oz. Can = Car driven 1,000 miles
- **CA inventory ($MMTCO_2E$)***

US EPA Vintaging Model			AB 1493
2006	2020	2030	2010
~7	~12	~15	~3

- **> 5% of total fuel use is for A/C operation (NREL)**

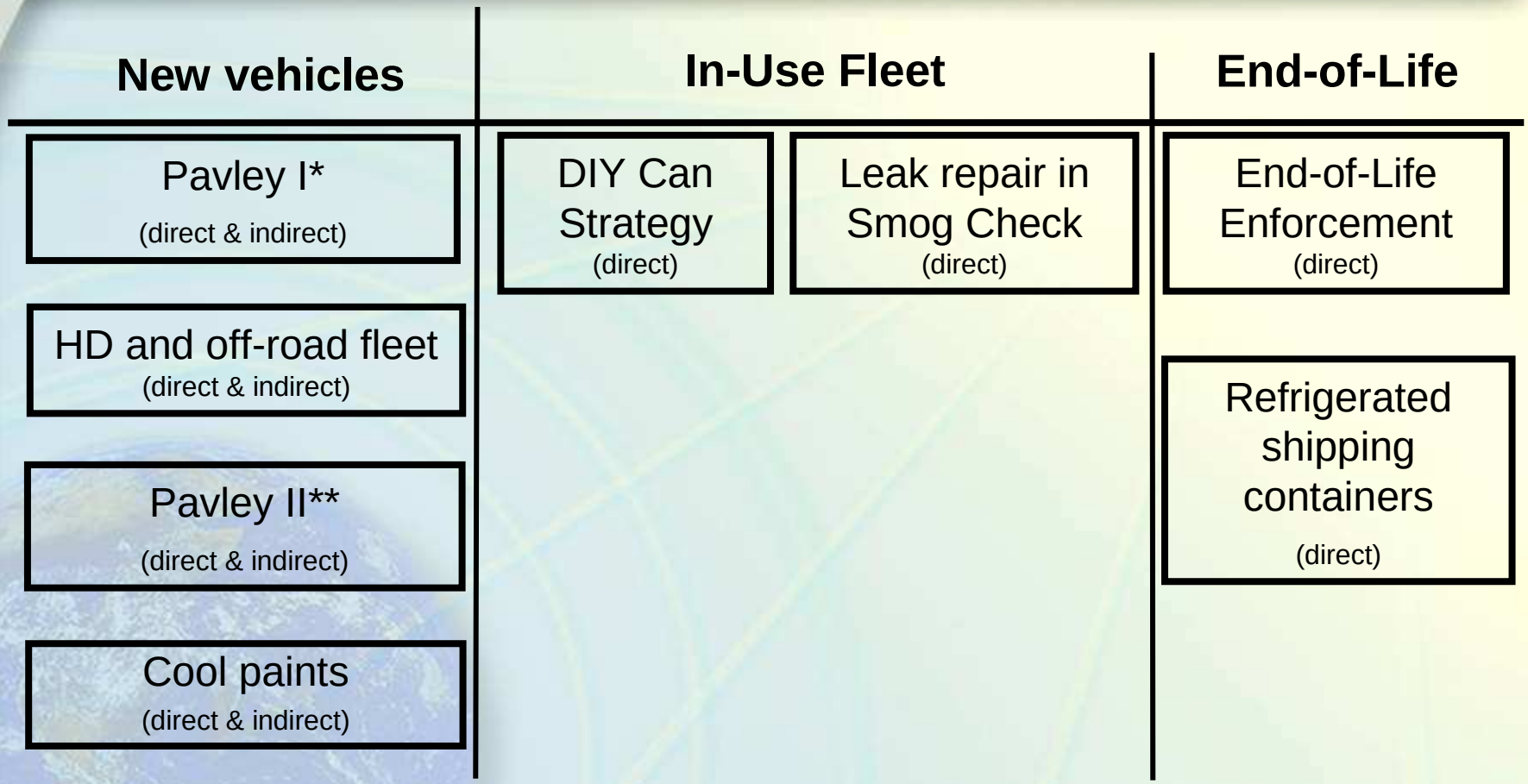
Average CO_2E emissions – AB 1493



- **No one sector being singled out**
- **Mitigating Global Warming will require participation by all**

* AB 1493 is for LDVs only

Cradle-to-Grave Suite of Strategies



*** Pavley I: Existing vehicle GHG emission standards (AB 1493)**
**** Pavley II: New vehicle GHG emission standards**

MVACs Refrigerant Mass Balance

Mass in = Mass out

Initial OEM charge in new vehicle

Re-charge:
1) DIY or
2) Professional servicing

System leak

System accidental breach

EOL

Can heel

Servicing leak

To MVAC **To environment** **Not addressed**

Section 2.1
DIY Small Can Regulation

Federal Perspective on Disposable Containers

Winston Potts
California Air Resources Board

Prepared by Jeff Cohen and Karen Thundiyil
U.S. Environmental Protection Agency

Section 2.2
DIY Small Can Regulation

CARB's Small Can Users in Mobile A/C Study

Winston Potts
California Air Resources Board

Prepared by Dr. Denis Clodic
Center for Energy and Processes, Paris School of Mines, France

Section 2.3
DIY Small Can Regulation

Refrigerant Use in the Mobile A/C Service Industry

Ward Atkinson
Society of Automotive Engineers
Interior Climate Control Standards Committee

Section 2.4
DIY Small Can Regulatory Options

Winston Potts
California Air Resources Board

DIY Small Can Regulatory Options

- **"Small Can" ban/restrict the retail sales of HFC-134a**
  - Eliminate DIY practice
  - Require professional servicing (servicing less emissive, but at much higher cost to consumers)
- **Current "Can Ban" rules in existence:**
  - 5 Air Districts ban sales of ODS refrigerants in "Small Cans" but not including HFC-134a (BAAQMD, SCAQMD, Monterey, Mojave, and Antelope)
  - Europe F-gas Directive (2007)
  - State of Wisconsin banned (1992) sale of all refrigerants (including HFC-134a) in "Small Cans"

Wisconsin Regulations

- **Since 1992, Wisconsin Department of Agriculture, Trade & Consumer Protection (DATCP) has regulated repairs of MVACs (ATCP 136, Wis. Adm. Code) as follows:**
  - Installing or servicing MVAC requires annual license
  - Require system inspection and leak repair – 'topping off' leaky system is prohibited
  - Refrigerants must be recaptured using approved recovery or recycling equipment
  - Refrigerant sales restricted to licensed businesses
  - Employees who operate recovery equipment are trained, tested, and certified by DATCP
  - Sale of containers holding less than 15 pounds is prohibited
  - Persons buying or selling refrigerant must keep sales and purchase records

DIY Small Can Emissions Estimate

- **ARB "Consumer Product 2007 Survey" data (2006 sales data)**
  - ~2M HFC-134a small cans sold in California in 2006
  - Consistent with industry's estimates
  - Estimated emissions = 0.85 MMTCO_2E
- **Estimate on can heels servicing emissions**
  - References:
    - ARB-sponsored small can users study
    - U.S. EPA disposable container study
  - 1/3 of all can contents are emitted due to servicing and can heel
    - Can heel: ~22%*
    - Servicing leak: ~11%*

*ARB Study, Denis Clodic, ARMINES of France.

DIY Small Can
Industry's Alternative Proposal*

- **Installation of self-sealing valves on all "small cans"**
  - $0.25 new cost per can
- **Used container return program - $1 deposit returned**
- **Used containers collected/HFC-134a recovered & recycled**
  - A new deposit/return program
  - ARPI estimated an additional $0.75 per can to administer program

*Submitted by Automotive Refrigeration Products Institute (ARPI)

DIY Small Can Issues on Recycling

- **Recycling motivators**
  - Need to evaluate effectiveness of recycling proposal (e.g., focus groups, pilot program)
  - Require enforceable, workable program
- **Two potential recycling approaches**
  - Municipal collection
    - Local/State administration
    - Transfer station or curbside pickup
    - Undetermined costs and mechanics
    - Probably not viable
  - Consumer return to retailer
    - Impacts consumer, retailer, manufacturer
    - Move towards increased manufacturer responsibility
    - Reclamation by industry or third party (similar to dry cleaning industry)
    - Possible Pilot Program to determine feasibility, effectiveness

DIY Small Can Strategy Future Activities

- **First workshop: February 5, 2008**
- **Join the working group**
  - First working group meeting: February 14, 2008
  - Stakeholders and interested parties are invited
  - Discuss small can regulatory options and scoping plan
  - Open to consider other options/combinations of options
- **Second workshop: May/June 2008**
- **Staff report available for public review and comment: July/August, 2008**
- **Board hearing: November 2008 ~ January 2009**
- **Regulation effective: January 1, 2010**

Section 2.5
DIY Small Can Regulation

Industry Study/Perspective

Norm Plotkin

Automotive Refrigerant Products Institute

Section 3
Other MVACS Measures

Informing Early Actions Plan and Scoping Plan

Dorothy Shimer
California Air Resources Board

Mitigation of Existing MVACs Impacts

- **Add requirements for A/C technician certification and servicing procedures**
  - Multi-tier certification (basic + advanced)
  - Improved procedure for leak identification and repair
- **Adopt latest standards for servicing equipment and components**
- **Restrict sale of disposable refrigerant containers**
- **Limit handling of refillable refrigerant containers to only certified technicians**
- **Other ideas?**

Potential Requirements for New MVACs

- **Apply to new HDVs, LDVs, On-Road and Off-Road; Evaluate opportunities for in-use fleet**
- **Phase out high-GWP HFC-134a refrigerant and align with international push towards low-GWP refrigerants**
- **Promote superior MVACS design with best lifecycle performance: reduced direct & indirect emissions**
- **Advance technologies to lower cabin heat load and reduce A/C size and usage**

Global Developments for Next Generation Refrigerants

- **Possible alternative refrigerants**
  - DuPont/Honeywell refrigerant (HFO-1234yf, GWP=4)
  - HFC-152a: GWP~120, slightly flammable, minimal mechanical changes
  - CO_2 : GWP=1, operates at higher pressure, requires heavy-duty hardware
- **German auto manufacturers choose CO_2 to fulfill European Directive**
  - EU F-gas Directive 2006/40/EC
    - Bans MVAC refrigerants with GWP > 150
    - Effective: Jan 1, 2011 (new vehicle types)
    - Effective: Jan 1, 2017 (all new vehicles)
- **Other car makers are still exploring options**

Advancing Understanding of Issues and Options

- **Research in place**
  - Mitigate impacts from HDVs and off-road
    - HDV Refrigerant Leakage Study by ERG (75 vehicles)
  - Inventory improvement (in-house)
    - In-use Direct MVAC Emissions (Running loss SHED @ HSL) w/ 30 LDVs
  - FTP add-on to determine A/C indirect emissions
    - In-use Indirect MVAC Emissions (CSU Northridge/Univ. of Illinois)

End of Life HFCs in A/C Systems

- **Per federal law, vehicle salvage and disposal facilities must remove refrigerant from EOL MVACs**
- **CARB seeks to promote enforcement of existing requirements for recovery via audits of activities and documentation**
  - Research in place: Emissions of HFC-134a from auto dismantling and recycling (Foundation for California Community Colleges)
  - First public workshop: 2008, 4th quarter
  - Second public workshop: 2009, 2nd quarter
  - Board hearing date: 2009, 4th quarter
- **Develop strategy for decommissioned refrigerated shipping containers similar to MVAC service/dismantling strategy**
  - First public workshop: 2010, 3rd quarter
  - Second public workshop: 2011, 1st quarter
  - Board hearing date: 2011, 4th quarter

I/M and MVACs

- **Exploring potential to add leak check/repair requirement to I/M biannual check**
  - Mitigates recurring leakage emissions
- **Requires additional training & equipment costs**
- **California Bureau of Automotive Repair (BAR) is key partner**
- **Research in place on professional servicing**
- **Future activities**
  - First public workshop: 2010, 1st quarter
  - Second public workshop: 2010, 3rd quarter
  - Board hearing date: 2011, 1st quarter

Section 4
Comments and Questions

ARB Contacts

- **DIY Small Can & shipping containers**
  - *Winston Potts, wpotts@arb.ca.gov, 916.323.2537*
- **Low GWP refrigerant for new MVACs**
  - *Dorothy Shimer, dshimer@arb.ca.gov, 916.323.1503*
  - *Dr. Pablo Cicero-Fernandez, pcicero@arb.ca.gov, 626.350.6478*
- **End of life HFCs in MVACs**
  - *Dr. Tao Zhan, tzhan@arb.ca.gov, 916.445.9495*
- **A/C leak test and repair requirements to smog check**
  - *Dr. John Collins, jcollins@arb.ca.gov, 916.327.8097*

- **Manager, Dr. Tao Huai, thuai@arb.ca.gov, 916.324.2981**

- **Website: http://www.arb.ca.gov/cc/hfc-mac/hfc-mac.htm**